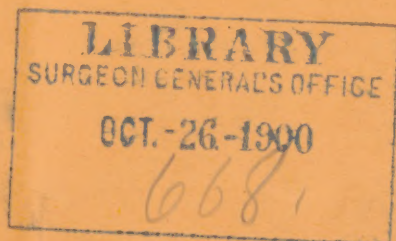


MACALESTER (R.K.)

Some Clinical Observations on the Action of the Thermal Waters of Glenwood Springs in Gout and Lithemia.

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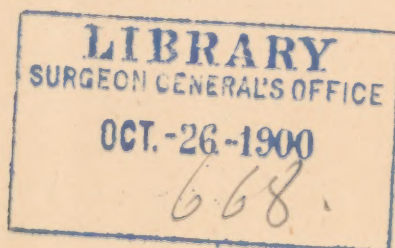
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The extremely favorable therapeutic results obtained in some cases of gout and lithemia by the use of the Glenwood Springs waters have induced the writer to offer the notes of a few personal observations, for the purpose of interesting the profession more widely in this most important and ever-growing branch of medicine, as well as being in compliance with the many requests of his *confrères* who have visited the resort.

Glenwood Springs, in the heart of the Rocky Mountains, at an elevation of 5600 feet, situated at the junction of the Pacific coast lines of the Denver & Rio Grande and Colorado Midland Railways, and at the conflux of the Grand with the Roaring Fork River, is indeed richly endowed by Nature with resources and attractions. The picturesque scenery of this region, amid chains of grand mountains, glistening rivers and brooks, bright valleys and bold scenic cañons, together with the incomparable climate, with its eternal sunshine and purity of atmosphere, make this an ideal spot for everybody seeking health, rest, or pleasure. Every effort has been made to meet the requirements of visitors making a short or prolonged sojourn here, even to the most fastidious taste. "The Colorado," a handsome, 224 x 260 feet stone structure, is fitted out with every modern comfort, managed in a most liberal manner, and is in every respect a first-class hotel. The extensive grounds around the establishment are a marvel of artistic taste and planning; the vivid green lawns, laid out in terraces, shady walks and alleys, the luxuriantly growing trees, bushes, and flower-plants, are all evidence of a well conceived plan and unrelenting energy to make this spot an attractive and popular health resort. Glenwood Springs is also famous as a starting-point for camping, hunting, and fishing parties, and there are many other sources of amusement, such as polo, tennis, golf, riding, driving, etc., so that the visitor is never at a loss for pleasant and healthful diversion.

The springs, situated on both sides of the Grand River, are numerous, about fifty of which are known, but there are probably many more which issue forth into the river-bed. The aggregate



flow is an inexhaustible one, estimated at 6000 gallons per minute; the constituency of the waters from the various springs is uniform, and the temperature 127° F. The analysis of the water, made by Professor Chas. F. Chandler, of New York, is as follows:

One U. S. Gallon Contains	*Glenwood Yampah Springs.
Sodium chloride	1089.8307
Sodium bromide.....	0.5635
Sodium iodide.....	trace
Sodium phosphate.....	trace
Sodium carbonate
Sodium sulphate.....
Magnesium chloride.....	13.0994
Magnesium bicarbonate.....	13.5532
Magnesium sulphate.....
Potassium sulphate.....	24.0434
Potassium chloride.....
Calcium sulphate	82.3861
Calcium bicarbonate.....	24.3727
Calcium carbonate.....
Lithium bicarbonate.....	0.2209
Iron bicarbonate.....	trace
Iron sulphate.....
Silica.....	1.9712
Alumina	trace
Total solids (in grains).....	1250.0411

It will be observed that this is a sulpho-saline-alkaline water, one of the most highly mineralized medicinal waters known, and extremely rich in salts most celebrated for their therapeutic value. The water is used for bathing and drinking purposes. A tumblerful, taken in the morning before breakfast, acts as a laxative, producing one copious, thin movement, apparently charged with bile, without the slightest griping.

The bathing accommodations comprise: (1) A three-story stone bath-house, 160 feet long, containing Roman baths, porcelain tubs, cabinet vapor-baths, douches, and a medical gymnasium for Swedish movements. In this building are also the doctor's office, laboratory, and reception rooms. (2) Adjoining the stone bath-house is the immense bathing pool, built of stone and brick, 600 feet long and 110 feet wide, with a depth of water varying from 3 to 5½ feet. The water is supplied by the adjacent Yampah spring, which yields 1700 gallons per minute, and is kept at an even temperature of about 90° F. at all seasons. This swimming pool is very popular among both health and pleasure seekers. (3) The vapor caves are unique, and very valuable adjuncts in the treatment of many complaints. These are small, natural caves in the rock at the riverside, in the floors of which springs of the same character as described above boil up, filling the space with vapor, carbonic acid, sulphurous

* Carbonic acid and sulphureted hydrogen are given off at the springs.

acid, and sulphureted hydrogen, and raising the temperature to 112° F. A few minutes' stay in this atmosphere suffices to produce profuse perspiration, which will continue after leaving indefinitely if not checked by cooling off. The original "Old Cave," said to be long known among the Indians and early settlers, proved inadequate to accommodate the increasing number of bathers, therefore the "New Cave," close to the hotel, has been utilized. Here a sumptuous cave house has been erected, fitted out with a large number of dressing-rooms, a spacious lounging-room, douches, showers, massage-rooms, etc.

LITHEMIA.

Before reporting individual cases, it may be well to briefly review what is known of the pathogenesis and the clinical features of this strange disturbance, in order that we may gain a better comprehension, and thereby direct our plan of treatment against the real cause, thus insuring therapeutic success.

The term lithemia, from *λίθος*, stone, and *αἷμα*, blood, means, strictly speaking, a disposition on the part of the blood to form insoluble deposits; these latter may be of any nature, and therefore the word may be applied very generally. Murchison, in his lectures on diseases of the liver, 1877, was the first to employ the term lithemia in the sense which has since been in vogue.

Lithemia, like gout, was originally supposed to be due to an oxalic acid diathesis (Prout, Golding-Bird), which underlying cause (oxaluria) was made responsible for the whole morbid condition. However, as early as 1856, Owen Rees (Croonian Lectures) already pointed out that oxaluria was not indicative of a diathesis, but that the oxalate of lime was formed after the urine had been secreted by the kidneys, and was derived from the uric acid and urates contained in the urine. The process takes place as follows: Oxaluric acid is formed by the oxidation of lithic acid, which is its only source; oxaluric acid is then converted into oxalic acid and urea, taking place in any part of the urinary apparatus after the urine has once been secreted, or in the last named on exposure to the air. Rees' views have since been corroborated by many investigators (Ed. Schank, Beneke, Ebstein, etc.).

Following the oxaluria epoch came that of the uric acid diathesis, which, notwithstanding that the views of leading investigators have undergone decided modifications, still exists at the present time. According to this theory, as originally formulated, uric acid was the sole culprit, and was made accountable for all the mischief in lithemia, and to a great extent in gout.

The weight of opinion to-day, based on extensive clinical and chemical evidence, tends to consider all lithemic disturbances as the result of faulty nitrogen metabolism, in which in the place of more highly oxidized products an excessive quantity of uric acid is present in the body, due either to overproduction or retention, and giving rise to an endless chain of symptoms in various organs and structures of the body. However, the most prominent authors, as, for instance, Duckworth, Garrod, Ebstein, Haig, Murchison, agree that uric acid, being an inert body, cannot *per se* be accountable for the trouble. Others believe that the xanthin bases, a group of the alloxuric bodies, and their compounds, circulating in the blood, probably give rise to the toxic symptoms (Kolisch), while the pains usually encountered in lithemia are referable to the mechanical action of uric acid salts upon the peripheral nerve endings (Barnes).

Whether the primary cause of the anomalous metabolic process is to be sought in impaired function of the liver (Murchison), in diminished elimination with accumulation of urates and other substances, owing to renal changes, in excessive production from overingestion of nitrogenous food with sluggish metabolism (Garrod), or to an abnormal acid reaction of the blood, are much mooted but still problematic questions.

The aggregate term lithemia comprises, therefore, a morbid vulnerable condition of the entire body, which, as pointed out in the foregoing, is the result of perverted metabolism, and consequently the presence of toxic, irritating substances in the blood. Therefore it is but plausible to infer that, under such circumstances, manifold organs and structures of the system should be prone to suffer impairment; and in reality the resulting clinical picture covers a host of multiform symptoms.

Among the symptoms that often arouse the physician's suspicions of the patient's being lithemic, the following may be enumerated: General physical debility, mental depression, irritability, at times a tendency to be melancholic, insomnia, headaches of various characters, neuralgia, migraine concurrent with or independent of gastric disturbances, vertigo, disorders of the gastrointestinal tract, chronic gastric catarrh, nervous dyspepsia, biliousness and bilious attacks, gastralgia, nausea, vomiting, rheumatoid pains in the back and extremities, often mistaken for chronic rheumatism, myalgia, irritable heart, increased vascular tension, etc. The occurrence of these symptoms, either singly or in groups, may conceal the true nature of the trouble, and simulate a definite type of disease, the character of which will be determined by the preponderant symptom. Thus,

for instance, if dyspepsia be the most prominent feature, the condition will be attributed to chronic gastritis; or headache associated with gastritis, idiopathic migraine; or an inexhaustible array of manifestations referable to many parts of the body, neurasthenia. This last named symptom-complex is of quite common occurrence, and the etiological relationship between it and lithemia is becoming more widely recognized of late years by general practitioners and neurologists. Dana, for instance, aptly describes the condition, under neurasthenia, as lithemia or nervous gout, a morbid condition due to accumulation of metabolic products. The nervous phenomena of lithemia have been described by Murchison, and exhaustively dealt with by Da Costa, McBride, Lyman, Hudson, and others.

The diagnosis is indeed perplexing in some cases of lithemia, but the physician who has had experience in this line will quickly recognize the trouble. Often the futility of treatment, directed toward the different symptoms or affected organs, will enable the physician to make the correct diagnosis sooner or later by discovering the etiological factor, which, if appropriately treated by antilithic measures, will promptly insure an amelioration of all the secondary symptoms. Barnes rightly says: "Lithemia stands in relation of cause and not effect." Therefore the diagnosis, if not fully established in a given case, may be corroborated *ex juvantibus*. The diagnosis may also be made chemically by a painstaking daily analysis of the patient's urine before and while undergoing treatment (*vide infra*, Case 3).

In the successful treatment of lithemia the two cardinal indications to be met are: Elimination of the causative toxic products from the system, and a subsequent prophylactic régime in order to prevent a recurrence or continuance of the evil. The consensus of opinion of the authors favors the alkalies and alkaline compounds, mineral waters, and thermal baths as being the most potent eliminating agents at our disposal. Sodium phosphate, sodium carbonate, potassium citrate, the lithia salts, the salicylates, etc., have all, by virtue of the neutralizing and diuretic properties, their warm advocates, but of late the lithia compounds and sodium phosphate seem to have become the greatest favorites. Indeed the last named drug, judiciously administered, has proved a very useful adjunct in the writer's hands. But all the aforementioned drugs are subordinate in eliminating power and curative properties to the natural mineral waters. That the popularity of mineral springs is great and ever growing is readily demonstrated by the throngs of health-seekers frequenting yearly the spas of Europe and this country. These

patients, after futile attempts to get cured at home by the usual routine methods and drugs, are finally advised by the physicians to try a course of treatment at one of the famous resorts, and they very generally find relief there.

It would be beyond the scope of this paper to attempt to discuss, comparatively, the merits, chemical properties, and physiological action of the Glenwood Springs thermal waters in reference to those of other springs. Suffice it to mention that many physicians interested in the matter, as well as the writer, after careful investigation, have convinced themselves that these waters rank among the highest in therapeutic efficacy.

As a drinking-water, "Yampah" has proved itself a useful remedy in many cases of lithemia. Taken as stated above, its action is that of a mild laxative; furthermore, of a diuretic (by increased absorption of water, due to the action of CO_2 upon the intestinal mucous membrane, Voit), and of a solvent and eliminator (by virtue of its high percentage of sodium chloride, dissolving mucus, liquefying bile, promoting the elimination of urea, and removing waste products). Sulphureted hydrogen acts also in an eliminating sense by stimulating the respiratory and circulatory centers, thereby raising the secretory and excretory functions in various organs (Stift).

The action of the waters, in the form of *baths*, is still more striking. A vapor cave bath of eight to ten minutes' duration is sufficient to set up an intense cutaneous reaction—a much shorter period than is required in ordinary fresh-water vapor cabinets or Turkish baths—which is followed by prolonged, unconscious perspiration, even if the patient rests in a moderate temperature and covered lightly. This process may, however, be readily interrupted by the application of cooling douches and showers, which is the method usually employed, except with robust persons wishing an intense reaction. This profuse and prolonged perspiration is difficult to explain satisfactorily, but the fact that the vapor must exert a specific, highly stimulating action on the sweat glands cannot be denied by anybody who has given it a trial. The analysis of sweat shows it to contain *de norma* urea and fatty acids, derived from the cyan alcohols of the body (Latham), and in rheumatic and gouty subjects, uric acid, urates, albumin, and calcium oxalates (Halliburton). Through the copious perspiration produced by a vapor bath, large quantities of these waste products must necessarily be excreted from the body, consequently this intense cutaneous reaction is a most important source of elimination.

In the form of tub and pool baths the thermal waters act very

similarly, although, generally speaking, in a lesser degree of intensity, so that on the whole they may be considered as milder procedures. These baths are prescribed in many conditions for eliminating purposes as well as for their local action upon the skin, by which the surface circulation is increased, congested organs depleted and returned to their normal tone, and *materies morbi*, elements of retrograde metamorphosis and detritus of various kinds may be removed (Baruch). The stimulating and refreshing action of baths in general is familiar to everybody, and needs no further comment.

Two other factors to be considered in connection with a sojourn in Glenwood Springs are the altitude and climate. The former, with its invigorating mountain air, is, as Weber holds, conducive to improved assimilation and nutrition, the formation of blood, stimulation of the nervous and muscular systems to greater activity, increased tissue change, etc., all of which are desirable adjuncts in the treatment of many disorders. The delightful climate, with its numberless bright days, makes outdoor life and exercise pleasant, and tends to keep up the patient's *morale*. Therefore it is not surprising that a course of treatment, judiciously carried out on the part of physician and patient, should be productive of most favorable results in lithemia and other diseases, when we consider the potent restorative agents that are active. The happy union of natural elements (climate, altitude, thermal waters), in conjunction with adequate accommodations and equipments, enable us to carry out in detail the requirements of a successful course of treatment.

The following cases will serve to illustrate some types of lithemia and demonstrate the therapeutic results during and subsequent to a course of treatment:

Case 1.—Mr. X—, 39 years, born in United States, drawing teacher, gives the following data: Rheumatic family history on paternal side. Personal history, malaria in boyhood. Patient was always high-strung. In 1888 he contracted gonorrhea; confesses to have committed excesses in Baccho et Venere, by fits and starts, for several years prior to 1889, but since then his habits have been regular, and he has been strenuously temperate. Dating from about the last named period he has been subject to headaches and vertigo, especially after meals, drowsiness in daytime and disturbed sleep at night, great depression of spirits, at times despondent, worrisome, and suspicious; feels that memory is poorer, with lack of ambition and physical strength; often great prostration for several days. Complaints of vague and sharp remittent pains in various parts of

the body, especially in the back and shoulders, of rheumatoid character; sexual desire diminished. Appetite fair, but does not relish food; some distress after meals, and often feels bilious; bowels usually constipated. No trouble in urinating, but thinks there are marked periodical variations in quantity of urine voided, it being for some time scanty and dark, then suddenly copious flow of light color.

Examination June 19, 1898. Well developed thorax and body, slender, and slightly emaciated. Weight 120½ pounds (normal 125), height 5 feet 7 inches. Mucous membranes decidedly anemic, face flushed, cyanotic; skin normal, acne vulgaris on forehead and back; pharynx congested with fine grayish patches. Fine regular tremor in tongue, hands, and fingers; knee-jerks, triceps, and periosteal reflexes lively. Radial and temporal arteries show increased resistance, pulsus celer, high tension, 88 per minute. Physical examination of lungs negative; area of cardiac dullness normal, heart action forcible, apex beat diffuse, irregular rhythm, no murmurs. Spleen moderately enlarged and indurated; liver normal. Urine light in color, specific gravity 1012; on boiling slight cloudiness (phosphates), disappearing on adding acids; contains no albumin or sugar.

The diagnosis of lithemia, with secondary neurasthenia and incipient arteriosclerosis, was made.

The prescribed treatment consisted in a light but nutritious diet, with a limited quantity of meat, a régime comprising plenty of outdoor life, exercise, but not to the point of overfatigue, and sufficient beverages (water, carbonated waters, milk); thermal tub-baths at the temperature of 98° F. for ten to fifteen minutes daily, and one large glass of Yampah at the spring before breakfast; also gargle with latter after meals.

Although a somewhat rebellious case, the patient improved steadily under this treatment, and in spite of several exacerbations the course of progress and final result can be best judged by the following brief notes, taken from the case-book:

June 26. Feels "shaky," with little ambition and energy; appetite and sleep better; pharyngitis improved; constipation troublesome. Continue treatment, increase Yampah to two glasses in morning.

July 3. Feels some lassitude when walking, and considerable mental depression, but decidedly less than at beginning. Weight same. Passes considerable urine of higher specific gravity and darker color than noted above, which shows on standing, micro-

scopically, a large quantity of urates. Complains of distressing pains in back. Continue treatment; ordered liniment to rub on painful parts.

July 10. Feels that he is gaining strength and progressing favorably in general. Continue baths. Ordered heaping teaspoonful of sodium phosphate to a glass of Yampah in morning. Some indigestion and gastric distress.

July 17. General health and digestion good; feels more composed, brighter, and stronger; can walk quite long distances and do considerable sketching without feeling exhausted. Ordered vapor cave every other day for eight minutes, followed by a rain shower for one minute, temperature 100° reduced to 70° , and rub down. Continue sodium phosphate and general régime. Pharyngitis entirely cured.

July 30. Complains of dyspepsia and nausea, which make him feel more nervous; otherwise doing well; scarcely any pains. Ordered condurango with muriatic acid and elixir lactopeptine. Discontinue vapor cave; resume tub-baths.

August 19. Great improvement in every respect; is bright and hopeful, taking interest in his occupation and surroundings. Color and muscular tone better, also general appearance; free from all pain, gastric disturbances, and mental depression. Returns home in a few days, as he states, "a different man," feeling quite able to resume his work, which he was obliged to abandon for a long time prior to coming here.

Case 2.—Mr. Z—, 27 years; born in United States; business man. Family history: Father died of chronic lung trouble; mother living, suffers from rheumatic gout. Personal history: Patient was always of delicate constitution, though mentally and physically active, and subject to colds which would often culminate in bronchitis or mild attacks of rheumatism. Habits excellent; alcoholic beverages in great moderation up to three years ago, since abstinence; smokes moderately. No venereal history. Can give no cause or exact date of onset of his illness, but is confident that it has been augmenting in severity during the past five years or longer. His present afflictions consist of severe headaches, biliousness, and general gastric disturbances, occurring every three to eight weeks, and lasting for several days. During these seizures he is entirely bedridden from prostration, is anxious, and feels great cardiac distress. As the attack terminates usually a greatly increased quantity of urine is excreted, after which the patient soon feels relieved. In the intervals is troubled more or less with dyspepsia. Suffers

furthermore from almost constant rheumatoid pains in thorax (intercostal), lumbar region, and extremities, which vary in intensity periodically.

Examination July 20, 1898. Height 5 feet 11½ inches; weight 135 pounds (maximal 160); long narrow thorax, ends of costal cartilages enlarged, suggestive of pectus carinatum; muscular system poor. Patient is emaciated and anemic; skin sallow; arteries normal, tension somewhat increased; pulse regular, rapid, 98 per minute. Nothing abnormal in the organs of the thorax and abdomen beyond slight epigastric tenderness and nauseating feeling on palpation over this region. Urine dark, clear, acid, specific gravity 1022; no albumin or sugar.

Assuming lithemia to be the underlying cause, patient was put on an eliminating treatment, due consideration being given the gastric symptoms. The course prescribed consisted of a daily cave bath, eight to fifteen minutes, with cooling douche and rub down, a glass of Yampah every other morning, strict, plain but nourishing mixed diet, plenty of outdoor life, and exercise in moderation. As a stomachic mist. rhei et sodii with tr. nuc. vom. was ordered before meals. After a fortnight the cave baths were substituted by tub baths, ten minutes daily at 100° F., the dyspepsia mixture discontinued, and laxative tablets, as required, prescribed. At the end of another fortnight pool baths of twenty minutes' duration were ordered at the patient's request, he feeling strong enough to enjoy swimming.

At the commencement of treatment the gastric symptoms and muscular pains seemed to become aggravated, but only temporarily; then rapid, steady progress set in, notwithstanding a couple of short relapses. At the end of ten days the pains had subsided, and after three weeks he experienced no evidence of gastric disturbances or headaches. After six weeks' duration the treatment was suspended; several weeks later patient started for home, to all appearances cured, and, as he stated, "leaving all his body ills and woes behind." During and subsequent to one of the gastric attacks, the urine was examined in reference to the amount of uric acid present, but with negative result, the ratio to urea not being materially changed, viz., 1 to 40 and 1 to 48 respectively. But the quantity of urine voided after the seizure being greatly increased (approximately 3 to 3½ quarts), so was also the total amount of uric acid excreted.

Case 3.—Dr. Henry H. Schroeder, of New York, resident physician here four years ago, reports, under "Uric Acid Diathesis,"

an interesting personal observation, a brief *résumé* of which follows: For six or eight weeks previous to arriving at Glenwood Springs, Dr. S—— had been the victim of the various symptoms of an attack of uricacidemia — *i.e.*, frequent headaches, acid eructations, coated tongue, constipation, an insurmountable sleepiness after meals, mental depression and irritability. The treatment consisted in a vapor cave bath every other day, drinking a glass of Yampah every morning before breakfast, and frequent swimming in the pool. The food consisted of a simple mixed diet. The daily quantity of uric acid and urea, estimated for twenty days, showed the ratio to be 1 to 32, an excessive amount of uric acid. On the twentieth day, after irregular fluctuations, the ratio became 1 to 56. The improvement in his condition after the first week seemed to keep pace with the changes in the ratio, so that by the fourth week he was restored to health.

GOUT.

Gout and lithemia are so closely allied, both pathogenetically and clinically, that they might be regarded as modifications of an identical primary process, varying in degree of intensity, and in the character and localization of the secondary symptoms. Thus, for instance, if we superadd to a case of lithemia the characteristic arthritic symptoms and deposits, we have a typical case of gout before us. Several other facts indicate the close relationship of the two disorders, as, for instance: Lithemia is frequently a precursor of gout; a person after being for years a lithemic subject finally ends by having typical arthritic attacks and gouty deposits; many gouty subjects evince in the intervals between attacks a condition showing all the characteristics of lithemia; some of the atypical attacks (visceral) occurring in inveterate gouty persons resemble the paroxysms of lithemia most strikingly. In the pathogenesis of both diseases, anomalous metabolism is considered by many eminent authorities to play a most important rôle, being, in all probability, the primary cause.

It will be well to cast a cursory glance into the etiology and pathology of gout before proceeding to the discussion of the action of thermal waters (see treatment), in order to gain an insight into this ever-perplexing domain.

Etiology. — Among the most widely recognized causes are: Heredity, in over 50 per cent of cases; luxurious mode of life with overfeeding, especially the excessive ingestion of nitrogenous food; errors of diet; sedentary habits with little exercise, consequently defective oxidation with resulting accumulation of metabolic waste

products; the inordinate use of alcoholic beverages; obesity, etc. Since the time of yore the greatest importance has been attributed to the prevalent customs of people, as the following familiar quotation will serve to illustrate: "During the Roman Republic, when the customs of the people were frugal and virtuous, gout was a rarity, but later, at the time of the Empire, when gluttony and excesses of all kinds were the fashion, it became remarkably prevalent, and even women were as frequently afflicted as men, they too being addicted to overindulgence."

Pathology.—Toxic and "poor man's gout" belong to a different category, and will not be considered here. In genuine gout, the most conspicuous pathologic findings are: The presence of uric acid in excessive quantity in the blood (*de norma* scarcely, if at all, traceable, it can be readily demonstrated before and during an attack by means of Garrod's thread test); fluctuations of the quantity of uric acid excreted in the urine, it being during the first part of an attack diminished, whereas subsequently it rises to above the normal amount of about 0.4–0.8 *pro die* (similar fluctuations in the excretion of urea and phosphates have been observed by Stokvis); and the presence of crystalline deposits of urates in various tissues with resulting circumscribed *negroses*.

Many ingenious theories relating to the origin and cause of deposition of urates in the living tissues have been advanced, but in spite of their warm advocates they have either been overthrown successively, or are still a matter of controversy. Among the most popular modern theories that have been established, the four following may be cited:

The hepatic theory assumes derangements of the hepatic functions to be the cause of accumulation of uric acid in the blood, with consequent deposition in the tissues. It is now an established fact that uric acid as such does not exist in the blood and tissues, but is always combined with sodium, as the quadriurate or biurate (A. P. Luff), and there is no proof of the liver being the seat of uric acid formation, as assumed by this theory. Therefore it is untenable.

Garrod's theory advocates that gout is, primarily, due to an excess of urates in the fluids of the body, and, secondarily, to their deposition in the tissues by precipitation in consequence of a diminished alkalinity of the blood. The crystallization of the biurate within the tissues, provoking inflammatory changes, acts like a mechanical injury to the parts involved. Notwithstanding the fact that this theory is supported by many eminent observers (Duckworth, Haig, Catani, Roberts, Ebstein, and others), still it is open

to serious objections. Thus, Klemperer and Luff have demonstrated by experiments that the alkalinity of the blood in gout is but very little if at all diminished, and that corresponding variations may frequently be met with in healthy individuals; furthermore, that a diminution of the alkalinity of the blood does not accelerate the deposition of sodium biurate, and that no general acidity of the system is associated with gout.

(A cleverly conceived theory of the cause of deposition of urates has recently been elaborated by C. Mordhorst, the salient points of which are: Gouty deposits occur only in structures of the connective tissue class, which are not supplied with vessels, but nourished by an endosmotic process. The fluids of these structures have a lesser degree of alkalinity, as Mordhorst's experiments have proved, which in conjunction with the lower temperature of the implicated parts—owing to their exposed, superficial position—is conducive to the deposition of uratic deposits. The objections to this theory are obvious from the discussion of the preceding.)

Ebstein's theory: This view holds that there is a local excessive production of uric acid, resulting from a peculiar metabolic anomaly, this morbid tendency being generally congenital, though it may remain latent for many years. The muscles and bones are considered to be, especially, the seat of the anomalous process, and the deposition in the joint cartilages as merely resulting from unusually favorable circumstances. The primary cause of gout is regarded by Ebstein to be due to a destructive process which always precedes the deposition of uratic crystals in necrotic, never in healthy, tissues. The neutral urate, in the dissolved state, acts as a chemical irritant, producing a necrotizing process in the implicated tissues, and resulting in complete necrosis, around which irritation sets in, which provokes the inflammatory phenomena of gout. During the necrotizing process a free acid is generated, converting the neutral urate of the fluids of the body into acid urate, which is then deposited in the crystalline form (biurate) in the necrosed areas. This, like so many other enticing theories, has been doomed by opposing views. Among the many objections that can be raised against Ebstein's theory are the following: (1) There is no proof of a local excessive production of uric acid in the muscles and bones, but strong evidence that in the kidneys is to be sought the seat of its formation (Garrod, Kolisch, Latham, Luff). (2) That crystalline urates are deposited only in necrotizing and necrotic tissues is in opposition to the experience of such eminent observers as Garrod, Roberts, Duckworth, and Cornil and Ranvier. Luff frequently examined sections

of cartilages which have shown no necrosis at the sites of uratic deposits. The recent careful investigations of Riehl demonstrate that uratic crystals are deposited in unaltered living tissues without a preceding necrosis having taken place, and that the failure of other investigators to find this condition is owing to their having examined tissues from the cadaver, or to faulty methods of hardening. The process of gouty nodule formation is probably a primary deposit of crystals in the lymph spaces, vessels, and connective tissue, and then a secondary inflammation of the surrounding tissues with the formation of granulation tissue and giant cells. Furthermore, crystals of the biurate have been found free in the synovial fluid of gouty joints, in which necrotizing processes could scarcely take place (Roberts)! (3) The neutral sodium urate—assumed by Eibstein to be circulating in the fluids of the body—being an extremely unstable compound, does not exist in the blood as such, but is decomposed in the presence of carbonates. On the other hand, Roberts has shown that uric acid is primarily taken up by the blood and lymph as a quadriurate, which acts in no way as a chemical irritant, especially in such a diluted state as it occurs in the system; and that the deposition of biurate is not accelerated by the presence of an acid. (4) Eibstein fails moreover to determine the nature or name his hypothetical acid. (5) In other diseases, especially in which leucocytosis occurs, sodium quadriurate may be present in considerable quantity without causing necrosis of any tissues.

The renal theory, of which Luff is an enthusiastic exponent, is based on scientific observations and deductions, and appears to be the most plausible at the present time. Luff argues that: (1) Gout is probably always preceded by some functional or organic affection of the kidneys, in all probability of the epithelium of the convoluted tubes, which interferes with the proper excretion of uric acid. In consequence there is deficient excretion (Fawcett, Luff, Pfeiffer) and subsequent absorption of the non-excreted portion of uric acid into the blood from these organs. (2) Normally uric acid is produced only in the kidneys, formed from urea, probably by conjugation with glycocine (Carrod, Kolisch). These two last named substances being brought from the liver, the formation and excretion of uric acid must necessarily be affected by alterations in the metabolism of this organ, and thus is explained why liver disorders and gout are associated with each other by some observers, as for instance by Duckworth and Murchison. (3) In health uric acid is eliminated at once in the urine, but if the uric

acid eliminating cells of the kidney are impaired, then its proper excretion is inhibited, and it is absorbed into the general circulation, from which the uratic deposits of gout are derived. This view is based on the fact that in other diseases, such as anemia, pernicious anemia, splenic tumor, leucocythemia, and others, uric acid has been demonstrated in the blood, with an increased excretion in the urine (von Jaksch, Klemperer). Therefore the conclusion is reached that the presence of uric acid in the blood is not pathognomonic of, and may be eliminated without causing, gout. (4) Uric acid has been found in the blood of all the cases of renal disease examined by von Jaksch and Klemperer, and among those of marked granular disease of the kidneys, uratic deposits were present in 77 per cent without having given rise to gouty symptoms during life (Luff). (5) It is a well established fact that certain toxic agents which predispose to or excite renal disease—lead, alcohol—are also productive of gout. The association of gout and plumbism is very common, and in the latter the development of kidney disease is also of extremely frequent occurrence.

Symptomatology.—Owing to the accumulation of pathologic products in the fluids of the body there develops a vulnerability of the entire system, which may become so great as to predispose to influences of various kinds, and successively every organ and part of the organism may become the seat of disease. The resulting clinical picture of gout is therefore composed of an endless variety of symptoms and types.

The symptomatology of gout has been treated so ably in many excellent works on the subject as to be familiar to most practitioners, and an attempt to describe the various symptoms here would seem presumptuous. However, in the classification of gout it is well to bear in mind three distinct types, viz.: (1) Acute gout, with the characteristic attacks, generally affecting one or two joints; (2) chronic gout, in which a number of joints become involved, the seizures more prolonged, and the affected parts remain crippled and deformed by the sodium biurate deposits remaining in them; (3) irregular or abarticular gout, in which it appears in other situations than in the joints (atypical gout, visceral gout, etc). This classification is, however, more or less arbitrary, there being many gradations and transitions in the phenomena and course of the disease and many cases presenting atypical features from their incipency (*vide infra*, appended Case 2).

Treatment.—The gouty patients coming to Glenwood Springs for the purpose of undergoing treatment being chronic cases, this form

of gout will be especially considered in the following. Acute cases may be cared for with equal benefit at home, baths being contraindicated during the seizures.

All the prophylactic, eliminating, and solvent agents enumerated in the foregoing under lithemia are in a great measure also applicable in the treatment of gout.

The conclusions of Luff, recently published, that ordinary alkalis, lithium salts, piperazine, and lysidin are useless, and sodium salicylate contraindicated, in gout, are based on the results obtained from his experiments, showing that these drugs do not prevent the deposition or increase the solubility of the biurate. While these views are theoretically correct, they are not altogether corroborated by clinical experience, and many practitioners find some of these remedies very serviceable in numerous cases of gout. In the writer's hands the alkalies, especially sodium phosphate, have proved valuable therapeutic adjuncts, while the large majority of gouty subjects have been found to be intolerant to the salicylates, owing to the ensuing gastric disturbances.

The therapeutic action of chemical compounds in the form of mineral waters is indisputably much more powerful than in the solid state, and thus may be explained the greater efficacy of natural waters over these salts. The virtues of the alkaline sulphated waters have been recognized from time immemorial in the treatment of gout, both for internal use and especially bathing purposes. The Yampah drinking-water is especially indicated in those cases of gout so frequently associated with gouty dyspepsia, gastrointestinal catarrh, torpor and congestion of the liver and portal system (abdominal plethora), gouty glycosuria, and catarrh of the respiratory organs due to circulatory disturbances in the abdomen (K. Grube). The beneficial action of this water, as a laxative, keeping the gastrointestinal tract in a normal condition, and relieving the bowels of all accumulated waste products, has been discussed in the treatment of lithemia.

The action of the plain and especially the vapor cave baths in producing an intense cutaneous reaction, as well as the important part they play as eliminating agents of uric acid and other *materies morbi*, have also been dwelt upon in the foregoing. The observation of a white coating of the skin, consisting principally of urates, which occurs in some gouty subjects after profuse perspiration, is additional evidence of the highly eliminating action of this structure. In general, the eliminating action of mineral water baths is accepted, and it is very probable that they exert a powerful influence in the

prevention of gouty manifestations and the formation of uric acid. E. Pfeiffer's experiments show that after subjecting gouty patients to twenty mineral baths there was a diminution of 50 per cent or more of the uric acid excreted, whereas in healthy persons this remained virtually unchanged. Furthermore, baths may be of distinct benefit in the treatment of gout by relieving the kidneys; this is by virtue of their diuretic action, the amount of urine excreted being increased after a bath.

In cases of gout dependent on lead poisoning, or associated with diseases of the skin, such as chronic eczema, prurigo, acne, psoriasis, the beneficial effect of these sulphur water baths is most remarkable, and their action upon such cutaneous affections is indeed quite specific.

Our knowledge of the *modus operandi* of mineral waters and baths is still very limited. In spite of innumerable experiments demonstrating the contrary, there is no conclusive evidence of absorption of salts in solution by the skin, the positive results obtained by some observers being in all probability due to experimental errors (Wegele). On the other hand, it is unquestionable that absorption of gases and volatile substances takes place through the skin, which is of some, though of minor, importance in the action of certain baths. Thus, in the alkaline sulphated baths, the sulphureted hydrogen present is taken up by respiration and through the skin in small quantities, and acts as a stimulant to the respiratory and circulatory centers.

The presumption of a solvent action of mineral waters on gouty calculi and deposits has long been refuted. Niemeyer supposes the favorable action of certain waters on gout to depend upon the reduction of plethora, due to a disproportion between supply and demand in the body (Walton). In a prophylactic sense, mineral waters and baths are probably serviceable in eliminating the sodium quadriurate circulating in the blood before it is transformed and deposited in the form of the biurate. In view of the fact that uratic deposits are found in unaltered living tissues, it is quite plausible to infer in a given case that the further deposition may be prevented before secondary inflammation sets in, and the formation of fresh crystals interfered with, by an appropriate course of treatment. The climate and altitude of Glenwood Springs are also extremely useful adjuncts in the treatment of gout by keeping the system toned up, capable of improved assimilation, etc. The selection of an appropriate climate is very important; elevated, dry, and warm places are beneficial to gouty subjects, whereas damp, cold climates generally disagree with them (Grube).

Regarding *diet* and *régime*, opinions differ so radically that it remains more or less a matter of personal experience and routine on the doctor's part as to his option of the course to pursue. The majority of authorities favor a regimen restricting the total amount of ingesta in order to promote metabolism. Others are still more rigorous, limiting the amount of carbohydrates and fats (in order to allow of thorough oxidation of the albuminoids), and the albuminoids especially (to prevent the excessive formation of uric acid), and prescribing a mainly vegetable diet, a great deal of exercise, and avoidance of certain foods and alcoholic beverages supposed to be conducive to the formation of uric acid. In some European spas the injunctions are carried out so strenuously as to measure and weigh the different ingredients of the patient's dietary, prescribing the distance to be walked daily, etc. In many cases these may prove of more theoretical than practical value, as many observers, including the writer, have had ample opportunity to convince themselves. In deliberating upon the appropriate course to be pursued in a given case, the patient's previous habits and personal experience, general condition, individuality, idiosyncrasies, etc., must be taken into account. The secret of successful treatment in gout lies more in using good common sense and individualization than in routine. In corpulent gouty patients a rigid restricting diet and regimen may be indicated, whereas in emaciated, cachectic cases, a more liberal, mixed diet is a *conditio sine qua non* to their recovery.

H. C. Wood aptly puts the question of diet, briefly stated, as follows: "There is no diet for gout. It is diet for the individual before us. Some gouty patients are at once reduced if they take starch or sugar, while others have to take farinaceous diet to build up. The case may often be judged by the effects of experiment. A milk diet is one which probably suits the large majority of patients. A diet must be ordered according to the individual, but one that suits the individual, the stomach, the digestion, will suit or kill the gout."

Many patients are aware of what foods and mode of life agree or disagree with them, but have not the strength of will to deny themselves what they know to be injurious; by a little admonition on the part of the medical adviser they may be induced to practice abstinence or great moderation, as well as to follow out the prescribed regimen.

Some interesting experiments, showing the influence of the mineral constituents of meats and vegetables, respectively, on the solubility of sodium biurate, have been undertaken by Luff. The

results obtained show that the mineral constituents of meat diminish the solvency of sodium biurate, whereas it is increased very considerably by those of vegetables. In a table the vegetables are arranged in order of their greatest solvent effect, beginning with spinach and ending with green peas. From these experiments Luff concludes that the mineral constituents of vegetables, if taken in sufficient quantities, would delay the advent of an attack of gout, and also exert a solvent effect on gouty deposits. From other experiments, showing that the mineral constituents of some vegetables delay the conversion of sodium quadriurate into the biurate, it is inferred that under favorable circumstances the elimination of the former might be secured without the occurrence of any precipitation of the biurate in the body. Luff suggests the use of a table salt prepared from vegetables instead of common salt, the former increasing the solubility of sodium biurate, while the latter diminishes it. Furthermore, Roberts found that sodium chloride, introduced into blood-serum containing sodium quadriurate, hastened the formation and precipitation of the biurate.

From the foregoing it would seem that the time-honored belief in the curative properties of a mainly vegetable diet in gout were based on more than empiricism, since it is corroborated by these experimental investigations. At the same time, it must be borne in mind that to consume the amount of proteid matter required for our nutrition, if taken in the form of a vegetable diet only, would necessitate the ingestion of such large bulks of vegetable food as to cause digestive disturbances in most cases. Therefore meat, being the most concentrated and digestible form of proteid material, is indispensable in certain proportions, and the diet for the gouty should in general be a *mixed* one, with an abundance of fresh vegetables. Contrary to the belief of many, it will be observed that the excessive use of common salt is injurious in gout.

The above experimental proof of spinach ranking first among the vegetables exerting a beneficial effect on gout is a very interesting observation for the writer, who without knowledge of it has been for a long time a strong advocate of this vegetable for his gouty and rheumatic patients.

In conclusion, a word in regard to the *application of mineral waters and baths*. In the treatment of gout, as well as other diseases, by thermal waters, judgment and individual gradation must be exercised. Baruch believes that though water appears to be so simple a remedy, nothing in the entire materia medica demands a like judgment and care in its application. At Glenwood Springs,

as at all other similar health resorts, the most *baneful consequences* have been observed through the *injudicious conduct* of certain headstrong *patients*, who follow some friend's advice, or take upon themselves to prescribe their own course of treatment, independently of a doctor's advice, or who act in opposition to his injunctions and warnings. By submitting to a moderate, on the whole liberal, regimen, conducted by a competent physician, all such dangers can be easily avoided, and the best therapeutic success insured.

The two appended cases, with notes from the writer's case-book, will suffice to illustrate the salient clinical features of gout, and the results obtained by a course of treatment at the springs. Case 1 is a fair example of typical gout, simple in character, but which had become chronic. Of interest is the rapid dissolution of the joint deposits and the relation between the improvement and the urine excretion. As the specific gravity and sediment increased, the dependent symptoms improved, which would indicate faulty renal excretion, although in the urine there was no chemical or microscopical evidence of kidney disease. Case 2 shows a chronic and most rebellious type of gout, with atypical manifestations. The resemblance to lithemia—outside the arthritic symptoms—with neurasthenic tendencies, was striking. In spite of the severity and stubbornness of the case, it will be observed that a most favorable, and to all appearances permanent, therapeutic result was obtained.

Case 1.—Mrs. S——, 62 years old, married, born in Germany, gives the following history: Is not aware of any rheumatic, gouty, nervous, or tuberculous troubles in her antecedents. Patient had five normal confinements, menopause at 42 years, and was always healthy up to five years ago, when she became the victim of rheumatism in various parts. Four years ago she was seized with a sudden attack of intense pain, swelling, and redness in the second joints of both great toes, which lasted for several days, and then subsided for six months. Has had similar seizures since, occurring two or three times yearly, involving successively one of these joints, then the other, as well as the metacarpo-phalangeal joint of right index. As the trouble progressed, she noticed that the duration of the attacks increased, lasting from three to seven weeks, and in the intervals the implicated joints remained blue, swollen, and painful.

Examination August 12, 1898. Small, healthy, though somewhat emaciated and anemic looking woman. Pulse small, regular, 82 per minute; peripheral arteries of normal consistence for age. The affected joints of both feet and right hand considerably increased in size, about as large as a 25-cent piece and a dime

respectively, were puffed, filled with exudation and deposit, which had a putty-like consistence, and were somewhat painful on pressure. When the swelling was at its maximum patient stated she could roll it about. The great toes were deformed, resembling halluces valgus. The physical examination was negative. The urinary analysis revealed urine of light color, Vogel 1, specific gravity 1006, with no evidence of albumin (boiling, acids, and Essbach's test) or other abnormal ingredients, and no sedimentation on standing.

A diagnosis was made of gout, secondary anemia, and malnutrition.

Owing to patient's delicate constitution a mild course of treatment was prescribed, consisting of tub-baths, temperature 96°, for ten to twenty minutes daily, half a glassful of Yampah before breakfast, a moderate amount of outdoor exercise, and a plain but nourishing mixed diet with avoidance of all indigestible dishes. Ordered: Tablets iron pyrophosph. co., for anemia. Under this régime patient showed immediate and steady improvement. Five days after beginning treatment the urine became much darker in color, the specific gravity rose to 1017, and the sediment showed quite a number of uric acid crystals and urates.

On August 23—*i.e.*, eleven days after instituting treatment—there was noted great improvement in every respect. The affected joints diminished in size to a remarkable degree, exudation and puffiness disappeared entirely, leaving some hyperostosis, skin still congested, but no soreness on pressure, and felt pain only after considerable exercise; was better and stronger in general, and color improved. Urine 1018; no albumin or sugar. From this time on, up to her departure on September 8, the patient took tub-baths every alternate day, continuing the same regimen, and on leaving there was no evidence of gouty or other arthritic trouble, except a slight enlargement of the extremity joints, almost physiological in elderly persons.

Case 2.—Mr. Z—, 32 years old, born in United States, gave a history of rheumatic gout in several members of his family on maternal side. Patient was afflicted with several attacks of rheumatism during childhood. In 1892 he acquired a chronic gastrointestinal trouble (dysentery?), probably of malarial origin, and has since been subject to attacks of dyspepsia, flatulence, and looseness of bowels. Habits excellent; never indulged in alcohol, tobacco, or other excesses. Had three attacks of lumbago within two years. Sprained the left knee two years ago while running, and since then the trouble seemed to settle there, the inflammation and swelling

remaining, in spite of attempts to cure it by tapping and other measures. Finger-joints of both hands painful and swollen; also joints of left foot. Patient took a full course of treatment at the Hot Springs, Va., in 1896, and another in 1897 at Aix-les-Bains, with some relief at the time, but with no permanent results. He gave a fair history of neurasthenic symptoms, such as becoming easily exhausted mentally and physically, sense of great prostration, vertigo, spells of "the blues," etc.

Examination June 14, 1898. Sallow, anemic looking; facial expression intelligent, but lacking animation, depressed. Somewhat emaciated; weight 122 pounds (normal 130); height 5 feet 7 inches. Arteries above normal resistance, well filled, pulse small and celer, 72 per minute. Left knee painful on pressure, considerably enlarged, especially anteriorly and laterally, and filled with fluid, resembling hydrops genu. Heel of left foot and joints of the two outer toes considerably swollen. All the finger-joints enlarged, especially right little finger, some containing exudation and nodules. Nails atrophic, brittle, corrugated, with numerous white spots, matrix detached in places. Physical examination of heart and lungs, negative; spleen slightly enlarged and indurated; urine clear, acid, specific gravity 1014, no albumin or sugar or pathological ingredients in sediment on standing.

A diagnosis of gout (marked neurasthenic symptoms) was made.

Treatment consisted of vapor cave bath eight to fifteen minutes daily, douche 100° to 80° for one minute, and general massage; local application of water to affected parts; half a glassful of Vampah before breakfast; mixed diet and moderate exercise.

July 3. Has taken baths regularly. Feels rather exhausted. Hands better; left knee more swollen, pains less on pressure. Doing well in general. Ordered: arsenauro ℥ v-x, t. i. d. as a tonic.

July 12. Affected parts still swollen and tender, especially tendons of hands. Uses moss poultices (the moss is an alga species that grows in the water of all the springs) on left knee at night, which give some relief. Discontinue cave, take tub-baths, 98° for fifteen minutes daily, with massage. Vampah with sodium phosphate in morning; arsenauro ℥ xv t. i. d.

July 29. Feeling about the same, though hands are more limber and less swollen; color and complexion improved. Is certainly gaining in physical strength. Complains of anorexia and dyspepsia. Weight remains unchanged. Took tub-baths for about one month, then resumed the cave baths.

August 25. Went up in the mountains at an altitude of about 10,000 feet for eighteen days; lived mostly in the open air, with somewhat primitive accommodations. During this time felt perfectly well and strong, free from pain and digestive disturbances, with excellent appetite, and able to do much hunting, fishing, and quite long walking tours. Returned home afterwards feeling in every sense benefited, capable of resuming his occupation, and confident that the Glenwood waters far excel any others in his experience.

Patient was seen six weeks and seven months later, respectively, and showed that the after-effect of the cure was most beneficial, with great amelioration of all symptoms, and that he had been capable of attending to a large amount of trying and confining work during the autumn and winter.

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